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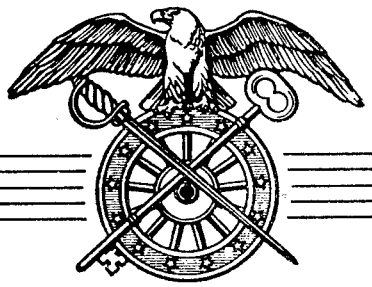
Report No. 194

WEIGHTS OF ARMY PERSONNEL

Quartermaster Climatic Research Laboratory



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Department of the Army
OFFICE OF THE QUARTERMASTER GENERAL
Research and Development Division

Environmental Protection Branch
Report No. 194

THE ASSESSMENT OF MILITARY PERSONNEL BY 1912 HEIGHT-WEIGHT STANDARDS

By

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From
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Lawrence, Massachusetts

64-02-001

November 1952

THE ASSESSMENT OF MILITARY PERSONNEL BY 1912 HEIGHT-WEIGHT STANDARDS

Abstract

Purpose. This study was made to establish and compare relative weights in three Army series, White male separatees measured in 1946, Negroid male separatees measured in 1946, and White male inductees measured in 1946 and 1949, with the height-weight table established by the medico-actuarial mortality investigation of 1909-1912, utilized as the standard in this assessment.

Summary. The three Army series were uniformly higher than the 1912 medico-actuarial standards in weight. The White and Negroid separatees demonstrated an unexplained decrease in the average relative weight with age. The White inductees did not show this decrease over the limited available age range. The largest Army group, White male separatees, was compared to two other standards, a European standard which proved unsatisfactory because age was not taken into account, and a study of civilians in 1940 by the Equitable Life Assurance Society. The Equitable Life data showed overall average weights that more nearly approached the Army data but a curious discrepancy in tall-statured men occurred.

Conclusions. The 1912 medico-actuarial data appeared obsolete when a modern military series was judged by these standards. The civilian population of the 1940's, measured at the time of induction into the Army, appeared to lie approximately midway between the military and 1912 series. Some unidentified military factor caused a differential addition of weight with age not found in the civilian data.

Recommendations. That new and better data be accumulated to replace the obsolete height-weight standards now in use. That the development of a physical standard criterion which avoids the limitations of relative weight be prosecuted and supported.

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Foreword

In this report are presented data and comparisons that appear to validate several rather well-accepted concepts. These concepts are that the individual changes with time, the race changes with time and that occupations, professions and modes of life leave their marks on the individual. It is of interest that these influences should be recognizable in such basic characteristics of man and the race as height and body weight. Even though these concepts have wide-spread recognition, it is surprising that in practice they are ignored or forgotten. To apply the standard man of 1912 in a 1952 situation is as unrealistic as applying 1930 technology to present day industry. Man and his world have both changed; the yardsticks used for comparisons must follow the changes.

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THE ASSESSMENT OF MILITARY PERSONNEL BY 1912 HEIGHT-WEIGHT STANDARDS

1. Introduction

By far the most familiar method of assessing the physical or nutritional status of adults is by comparison with so-called "standard" weight tables. Versions of such tables appear on penny weighing-scales, in physicians' offices, and are viewed by multitudes daily. Modifications of these data govern the medical selection of personnel for our Armed Forces. The sophisticated examples present weight in relation to height and age, but age is not mentioned in many simple and abbreviated versions. Basically, all of these tables go back to the same concept and even to the same source, the Medico-Actuarial Mortality Investigation of 1909-1912. The concept is that of determining the average weight for a large number of adults of the same height, sex, and age. Armed with this information, it is a simple matter to construct a table by which anyone can compare his weight to the average (expressed in whole pounds) for his height and age group.

There are several advantages and numerous disadvantages to the use of standard weight as a physical criterion. On the positive side it is, one, easy to measure. Most people know their height and it is a routine question if not actual measurement in physical examinations. Similarly, most individuals know their current body weight within reasonable limits, although the tables seldom say whether they refer to nude or clothed weight. Two, this measure has been collected for so long and checked so thoroughly against morbidity and mortality data that large amounts of statistics are available for comparison. Negatively, there are at least four disadvantages. One, the use of weight as the sole criterion obscures the fact that two men with identical height and weight may have markedly different proportions of bone, muscle, and fat.[1] Two, the standard weight is the average for a range of weights and obviously everyone cannot be expected to even approximate this average. Since this statistic is based on a distribution approaching a normal curve, (actually, weight is always slightly skewed right), approximately half of the population will always fall below and half above this central point. Three, there can be no reasonable basis for clinically delimiting underweight or overweight based on a biological continium such as the distribution of weight in a given age and height group. It is common practice to speak of individuals who deviate more than 20 percent from standard weight as clinically undernourished or obese; in reality there is no magical line of demarcation. Four, this type of data gets out of date by its very nature. It is unreasonable to assume that any population has long remained static in regard to nutritional status in this century. Similarly, it is not feasible to apply data gathered in one country, e.g., the United States,

[1] Brozek, J. and A. Keys. "Limitations of the 'Normal' Body Weight as a Criterion of Normality." Science, 112:2922, 778, 1950.

to other areas on an individual basis. Comparisons between populations are meaningful only in very general terms so that it is possible to compare the average height and weight in India with that of the United States and say that Indians are grossly underweight by our standards. However, comparing standard weight between Indians is meaningful only when India has its own tables based on domestic data.

This report deals principally with the fourth disadvantage of the standard weight concept as listed above, namely, that tables based on an investigation carried out in 1912 are not appropriate forty years later, and newer data must be incorporated into our thinking and practice.

It would be even better if the whole concept could be reworked to eliminate all the obvious disadvantages, and the next decade may produce a measure as simple to obtain as standard weight without its defects. In the interim, however, standard weight will continue to be used in many circumstances and it should be based on the latest and best data.

2. Background

The data upon which this report is based consist of records on men measured in Quartermaster Corps anthropometric surveys in 1946 and 1949. Based on these surveys, three separate series are presented and compared: 28,288 White male separatees measured in 1946; 6,066 Negroid male separatees measured in 1946; and 12,988 White male inductees, 60 percent of whom were measured in 1946, the remainder were measured in 1949. The White separatees represent a geographically weighted sub-sample of a larger series of 85,000 men, while the Negroid separatees and White inductees represent the total available in these categories.

The data record for each man contained age, height, weight, and a large number of anthropometric measures. Relative weight, weight expressed as a percentage of standard weight, was not recorded and therefore was calculated in the course of the investigation for each of these men. These individual relative weights were grouped into workable frequency distributions which are presented below. No clinical data were available on these men, but it was presumed that the separatees had been exposed to varying lengths of military service and the inductees measured up to the Army induction medical standards.

All the statistics derived from the series presented here have been based on one-year age groupings since age is a very pertinent factor in consideration of body weight. Unfortunately, the age distribution in any military series is not evenly distributed with the preponderance of men occurring between 18 and 23 years of age. The size of the age-groups utilized here is shown in Table I and the graphic representations

presented later are best assessed in reference to the relative numerical strength of the various age groups.

TABLE I: AGE DISTRIBUTION OF THREE QMC ANTHROPOMETRIC SURVEY SERIES

Age	White Separatees	Negro Separatees	White Inductees
17	413	39	4326
18	991	64	4327
19	2995	1023	1555
20	6925	1665	776
21	1410	605	412
22	1139	478	417
23	1033	439	630
24	938	341	545
25	1007	320	
26	1071	295	
27	911	274	
28	1157	213	
29	1445	158	
30	1377	152	
31	1525		
32	1361		
33	1010		
34	887		
35	693		
Total	28,288	6,066	12,988

Two fundamental methods of ordering the Army data have been used throughout this report. One, the age groups have been sorted with the group limits falling at the exact year-points. Thus, all men who have passed their 20th birthday but have not yet arrived at their 21st birthday are included in the 20-year-old age group. The average age of this group was considered to be 20-1/2 years and the data were so plotted. Two, stature data have been grouped on the same basis; e.g., the 5' 6" height group contains men between 5' 6" and 5' 7", and the average for this group has been plotted at 5' 6-1/2". In lieu of evidence to the contrary, all other data with which these series have been compared have been ordered in a similar manner.

3. Presentation of the Data

a. Weight Expressed as a Percentage of Standard Weights.

The initial data collected for this report were the calculation of relative weight or percent standard weight on the White male separatee

series. The standard weight table against which the men were compared was derived from the 1912 medico-actuarial mortality investigations and copied from Davenport.[2] It is reproduced here as Table II. As has been stated previously, this table or at least these data form the basis of most weight standards. The percentage distribution of the White male separatee group expressed in intervals of five percent is given in Table III together with the usual statistics for each age group. This table has been designated as the "age-weighted" distribution to distinguish it from another analysis of the same group by a different standard weight criterion.

TABLE II: GRADED AVERAGE WEIGHT OF DIFFERENT STATURES AT VARIOUS AGES (from Davenport[2])

Age, years.	5 feet.	5 feet 1 inch.	5 feet 2 inches.	5 feet 3 inches.	5 feet 4 inches.	5 feet 5 inches.	5 feet 6 inches.	5 feet 7 inches.	5 feet 8 inches.	5 feet 9 inches.	5 feet 10 inches.	5 feet 11 inches.	6 feet.	6 feet 1 inch.	6 feet 2 inches.	6 feet 3 inches.	6 feet 4 inches.	6 feet 5 inches.
15	107	109	112	115	118	122	126	130	134	138	142	147	152	157	162	167	172	177
16	109	111	114	117	120	124	128	132	136	140	144	149	154	159	164	169	174	179
17	111	113	116	119	122	126	130	134	138	142	146	151	156	161	166	171	176	181
18	113	115	118	121	124	128	132	136	140	144	148	153	158	163	168	173	178	183
19	115	117	120	123	126	130	134	138	142	146	150	155	160	165	170	175	180	185
20	117	119	122	125	128	132	136	140	144	148	152	156	161	166	171	176	181	186
21	118	120	123	126	130	134	138	141	145	149	153	157	162	167	172	177	182	187
22	119	121	124	127	131	135	139	142	146	150	154	158	163	168	173	178	183	188
23	120	122	125	128	132	136	140	143	147	151	155	159	164	169	175	180	185	190
24	121	123	126	129	133	137	141	144	148	152	156	160	165	171	177	182	187	192
25	122	124	126	129	133	137	141	145	149	153	157	162	167	173	179	184	189	194
26	123	125	127	130	134	138	142	146	150	154	158	163	168	174	180	186	191	196
27	124	126	128	131	134	138	142	146	150	154	158	163	169	175	181	187	192	197
28	125	127	129	132	135	139	143	147	151	155	159	164	170	176	182	188	193	198
29	126	128	130	133	136	140	144	148	152	156	160	165	171	177	183	189	194	199
30	126	128	130	133	136	140	144	148	152	156	161	166	172	178	184	190	196	201
31	127	129	131	134	137	141	145	149	153	157	162	167	173	179	185	191	197	202
32	127	129	131	134	137	141	145	149	154	158	163	168	174	180	186	192	198	203
33	127	129	131	134	137	141	145	149	154	159	164	169	175	181	187	193	199	204
34	128	130	132	135	138	142	146	150	155	160	165	170	176	182	188	194	200	206
35	128	130	132	135	138	142	146	150	155	160	165	170	176	182	189	195	201	207
36	129	131	133	136	139	143	147	151	156	161	166	171	177	183	190	196	202	208
37	129	131	133	136	140	144	148	152	157	162	167	172	178	184	191	197	203	209
38	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	198	204	210
39	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	199	205	211
40	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	206	212
41	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	207	213
42	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
43	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
44	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
45	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
46	134	136	138	141	144	148	152	156	161	166	171	177	183	189	196	203	210	216
47	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
48	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
49	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
50	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
51	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
52	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
53	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
54	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219
55 and up	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219

[2]Davenport, C.B. "Body Build and its Inheritance." Publ. Carneg. Instn. No. 329, 1923.

TABLE III: PERCENTAGE DISTRIBUTION OF RELATIVE WEIGHTS IN WHITE SEPARATEES

Percent Standard Weight	Age 17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
59.6- 64.5									0.10										
64.6- 69.5			0.03		0.07				0.10				0.07				0.20		0.14
69.6- 74.5	0.24		0.03	0.03	0.07		0.19		0.10	0.09	0.22		0.07		0.13	0.07	1.09		0.14
74.6- 79.5		0.10	0.13	0.27	0.21	0.18	0.29	0.75	0.60	0.84	0.66	0.69	0.55	0.80	0.59	0.88	3.66	1.13	1.15
79.6- 84.5	1.21	1.01	0.60	1.05	2.06	1.58	1.55	2.13	1.69	1.87	1.76	2.25	2.84	2.11	2.10	3.09	7.62	4.51	2.74
84.6- 89.5	3.15	4.44	4.21	4.29	4.89	4.30	5.23	4.37	4.67	6.07	5.27	6.14	6.85	7.77	7.41	8.23	14.06	6.76	6.49
89.6- 94.5	14.04	8.68	10.22	10.50	9.72	10.98	9.58	10.98	12.41	13.26	12.62	10.63	11.28	12.49	12.39	13.74	15.94	13.42	11.54
94.6- 99.5	16.22	17.26	15.09	17.24	17.30	15.28	17.62	15.46	15.00	16.81	16.46	17.11	16.75	17.21	16.33	16.24	16.34	18.72	16.74
99.6-104.5	21.55	15.93	18.46	20.59	17.45	19.05	19.36	18.34	20.16	17.74	13.39	17.89	17.99	15.61	17.05	16.53	12.97	14.99	16.16
104.6-109.5	19.61	20.28	18.40	16.91	14.96	19.32	14.33	16.10	14.70	12.88	13.83	13.48	14.26	14.31	14.49	15.14	10.40	12.63	15.73
109.6-114.5	12.35	14.33	12.76	12.26	14.75	11.59	11.62	12.90	9.93	10.74	14.49	11.32	11.14	11.69	10.69	10.80	6.24	11.95	11.83
114.6-119.5	5.81	7.97	9.18	7.70	8.30	7.29	7.55	8.42	9.04	7.56	7.68	7.69	7.61	6.97	7.93	6.61	4.16	7.67	6.64
119.6-124.5	2.66	4.44	4.74	3.77	5.04	5.00	5.90	3.20	4.37	4.95	5.60	6.22	3.39	5.16	4.20	4.12	3.66	4.28	4.62
124.6-129.5	1.94	3.13	2.44	2.30	2.34	2.55	2.03	3.30	3.28	3.18	3.62	3.80	3.74	2.54	3.67	2.13	2.28	1.13	3.03
129.6-134.5	0.48	1.11	1.37	1.17	1.21	1.49	2.42	2.13	1.39	1.31	2.42	1.12	1.87	1.45	1.44	0.96	0.89	1.35	1.30
134.6-139.5		0.50	0.94	0.78	0.71	0.62	1.06	0.96	1.19	0.93	1.32	0.86	0.90	0.87	0.66	0.81	0.30	1.02	0.14
139.6-144.5	0.48	0.20	0.40	0.61	0.43	0.26	0.48	0.43	0.79	0.75	0.22	0.43	0.42	0.51	0.52	0.22	0.10	0.22	1.01
144.6-149.5		0.10	0.23	0.26	0.36	0.18	0.29	0.11	0.20	0.84	0.22	0.26	0.28	0.29	0.20	0.07	0.10	0.11	0.14
149.6-154.5		0.10	0.37	0.03	0.07	0.18	0.10	0.11		0.09	0.22	0.09		0.07	0.07	0.22		0.11	0.14
154.6-159.5	0.24	0.20	0.17	0.13			0.10	0.32	0.10						0.13	0.15			
159.6-164.5		0.20	0.07	0.03	0.07		0.19			0.09									0.14
164.6-169.5				0.03			0.10		0.10					0.14					0.14
169.6-174.5			0.07	0.01															
174.6-179.5			0.10	0.01					0.10										
179.6-184.5				0.03															
184.6-189.5						0.18													
Number	413	991	2995	6925	1410	1139	1033	938	1007	1071	911	1157	1445	1377	1525	1361	1010	887	693
Mean	103.57	105.61	105.99	104.86	105.00	105.07	105.34	105.11	104.93	104.45	105.34	104.66	104.00	103.91	104.03	102.79	103.16	102.60	103.91
Standard Deviation	10.11	11.26	12.01	11.45	11.70	11.70	12.56	12.24	12.68	12.93	12.73	12.27	12.33	12.54	12.36	12.12	12.87	12.16	12.79

The calculated line of best fit for the average percent standard weights given in Table III is illustrated in Figure 1. This figure also shows the mean values and line of best fit for the same men when relative weight was calculated from data that was not "age-weighted". This second analysis was made by utilizing a formula derived from European data.[3] Since it does not take age into account, it was very simple to calculate, and it was presumably more up-to-date than Davenport's table.

The data for 17-year-old separatees have not been used in the calculations of lines of best fit, since the number of men is very small and the average is not compatible with the other age groups. The remarkably different slopes of the lines were not unexpected and merely served to emphasize that relative weight increases directly with age unless a correction is made. It is not possible to say how the European standard would compare with the medico-actuarial data if an age correction were added, but it appears that the Army group would still remain well above the 100 percent line.

The most interesting and instructive feature of Figure 1 is the large and persistent distance by which the averages of the Army group exceed that of the 1912 data. In terms of the small vertical dispersion of the mean values for the age-groups, it indicates that the American soldier upon separation from the service in 1946 consistently averaged from three to five percent above the so-called standard weight for his age and height.

It will be noticed that a distinct downward trend is indicated by the age-weighted data. This is even more surprising than the fact that Army men average more in weight than did their grandfathers. Is this a matter of something in military life which reverses the weight accretion with age found in civilian life or is this a matter of generational sampling, since the span of years covered here, 17 - 36, constitutes almost a generation?

Relative weight was calculated on 6066 Negroid separatees against the age-weighted tabular data (Table II), and the percentage distributions for each age group have been given in Table IV. No data have been used for age groups over 30 years of age because the very small numbers of men available for these groups (100 or less) gave the data poor reliability. The calculated line of best fit for the Negro separatees has been shown in Figure 2, and the age-weighted White separatee line included for comparison. The Negroid 18-year-olds appear to be somewhat aberrant, probably because of the small number represented, but this has not greatly influenced the line of best fit.

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[3] Odier, J. and R.S. Mach. "Le Volume des Liquide Extra-cellulaire chez les Abèses." Praxis, 38:834, 1949; as quoted by R.A. McCance and E.M. Widdowson in Proc. Royal Society, Series B, vol. 138, no. 890, 1951.

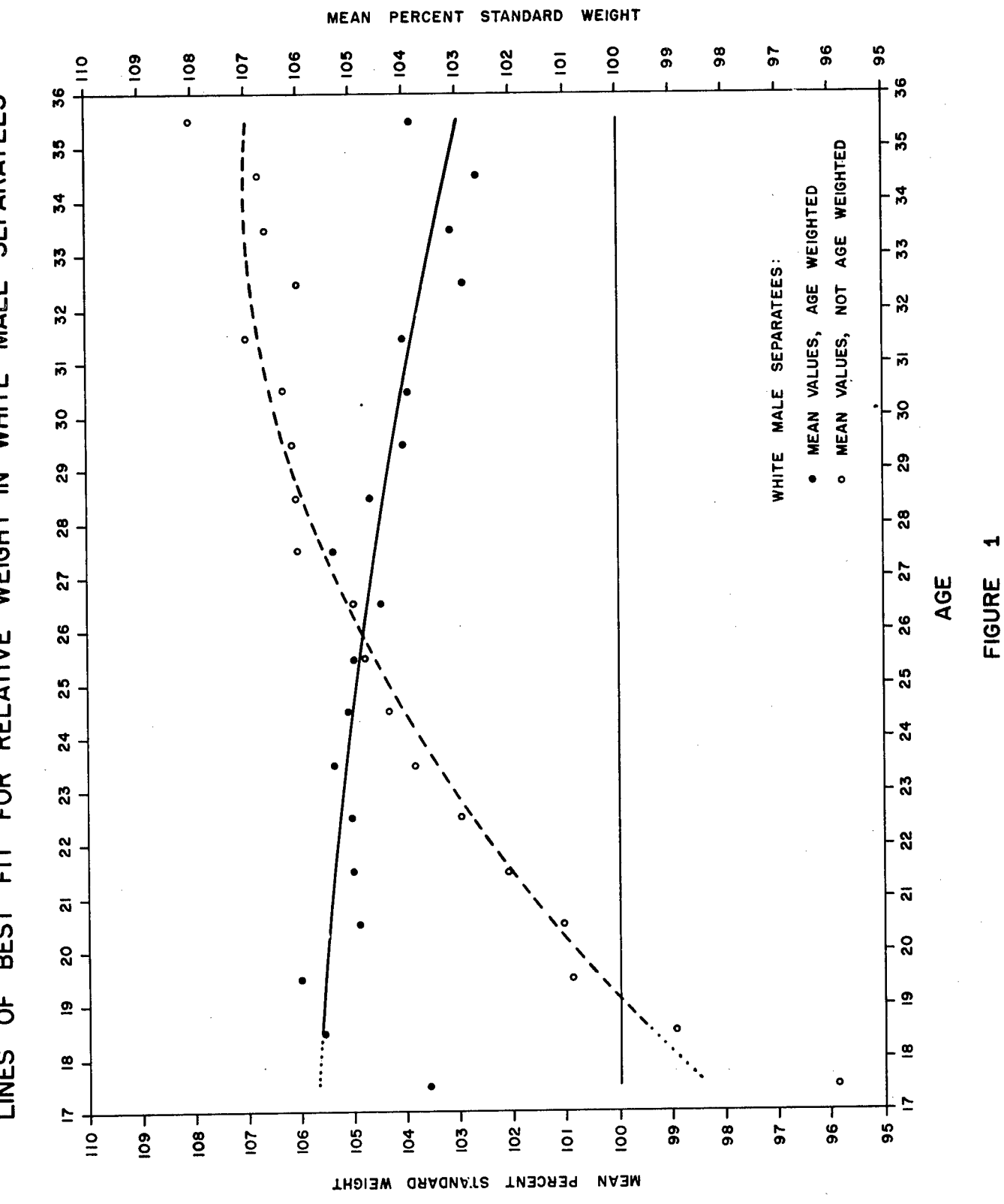

LINES OF BEST FIT FOR RELATIVE WEIGHT IN WHITE MALE SEPARATEES
MEAN PERCENT STANDARD WEIGHT
AGE
WHITE MALE SEPARATEES:
• MEAN VALUES, AGE WEIGHTED
o MEAN VALUES, NOT AGE WEIGHTED

FIGURE 1

TABLE IV: PERCENTAGE DISTRIBUTION OF RELATIVE WEIGHTS IN NEGROID SEPARATEES

Percent Standard Weight	Age 17	18	19	20	21	22	23	24	25	26	27	28	29	30
64.6- 69.5			0.10											
69.6- 74.5						0.42								0.66
74.6- 79.5			0.10	0.18	0.16	0.21		0.29		0.34	0.73	0.47	0.63	
79.6- 84.5	2.56		0.10	0.84	0.66	0.63	1.37	0.59	0.62	1.02	1.10	2.82	2.53	3.29
84.6- 89.5	2.56	3.12	2.64	2.40	1.65	3.77	5.24	4.69	5.00	3.39	6.20	6.10	8.23	5.92
89.6- 94.5	2.56	7.81	6.84	6.49	7.60	7.95	8.88	8.21	13.44	10.17	12.41	15.02	10.13	13.82
94.6- 99.5	12.82	17.19	15.15	15.86	16.03	14.44	16.86	17.30	17.50	13.56	16.06	15.49	15.19	17.76
99.6-104.5	23.08	17.19	18.96	20.06	21.32	18.83	17.31	21.41	18.44	26.44	16.79	17.37	20.25	18.42
104.6-109.5	25.64	21.88	20.92	20.24	20.16	20.29	20.50	16.72	13.44	14.92	17.52	17.37	16.46	15.13
109.6-114.5	15.38	18.75	17.40	15.68	13.72	16.32	9.80	14.66	11.88	13.90	12.04	10.80	12.66	11.18
114.6-119.5	5.13	9.38	8.90	8.65	9.42	8.79	8.88	6.74	7.81	6.44	6.93	5.63	8.23	5.92
119.6-124.5	2.56	3.12	4.79	4.62	4.30	4.39	5.70	5.28	5.31	3.05	5.11	6.10	2.53	2.63
124.6-129.5	5.13	1.56	2.05	2.46	2.98	2.09	2.73	2.64	3.44	3.05	2.92	0.94	2.53	2.63
129.6-134.5			0.78	1.26	0.83	0.84	1.14	1.17	0.94	0.68	1.82	0.47	0.63	0.66
134.6-139.5	2.56		0.78	0.42	0.50	0.63	0.68		0.94	2.37	0.36	1.41		0.66
139.6-144.5			0.29	0.36	0.50		0.46	0.29	0.31					
144.6-149.5			0.20	0.06	0.16	0.42	0.23		0.62					1.32
149.6-154.5				0.12						0.68				
154.6-159.5				0.12			0.23							
159.6-164.5				0.18					0.31					
Number	39	64	1023	1665	605	478	439	341	320	295	274	213	158	152
Mean	106.49	105.28	106.39	106.33	106.11	105.64	105.36	104.92	105.06	105.36	104.17	103.01	102.98	102.95
Standard Deviation	10.43	8.72	9.97	10.60	10.13	10.48	11.46	10.28	12.11	11.47	11.23	11.20	8.44	12.07

One important difference between the Negroid and White data can be seen in Figure 2. The young Negroid males are heavier for a given height than the Whites. Evidence not presented here suggests that this weight differential is due to heavier musculature (a heavy form of tissue) concomitant with less body fat (a light tissue) in young Negroids. The relative position of weights is reversed in the late twenties probably through the addition of larger amounts of fat on the Whites. Disregarding the small differences in the slope of the lines of best fit, it is now doubly apparent that Army separatees for some reason decline in relative weight with age when contrasted with the 1912 medico-actuarial standards.

The third group, men measured at the time of induction in 1946 and 1949, has been presented in Table V, and the calculated line of best fit compared with the age-weighted White separatees in Figure 3. The mean values for the limited available age-range are definitely lower than the separatee means and the inductee trend approximates the 1912 100 percent standard line in slope. From these limited data it might be possible to hazard that the civilian population has not fundamentally changed the slope of increased weight with age although the average weights are consistently higher.

b. Calculation of Standard Weight Tables Based on Separatee Data.

Average weights for successive increments of stature were calculated on each age group in the White separatee series. From these mean values it was possible to construct a "new" standard weight table for direct comparison with the medico-actuarial data. The actual mean values were smoothed and adjusted since the less popular heights were subject to sampling errors, and only stature intervals in which the data were felt to be adequate were included. In each case the modal stature interval, 5' 8", was used as the baseline and adjustments were made from this interval. The results are shown in Table VI in which appropriate data from Table II have been repeated to facilitate comparison. The Army data exceeded the medico-actuarial figures in the majority of cases as was to be expected from the mean differences illustrated in Figure 1. The discrepancies were least in the taller stature groups where the 1912 average actually exceeded the Army figures in some cases. This reversal of the major trend was caused by a uniform increase of weight with stature in the Army data and a differential increase in the medico-actuarial table. For example, the increases of weight with height in men of 20 years of age compare as follows:

	62"	63"	64"	65"	66"	67"	68"	69"	70"	71"	72"	73"	74"	75"
Army		4	4	4	3	4	4	4	4	3	4	4	4	4
Medico-Actuarial		3	3	4	4	4	4	4	4	4	5	5	5	5

There was no evidence of an increased weight grade with taller stature in the Army data. Both the year-by-year tabulations and the analysis of all

TABLE V: PERCENTAGE DISTRIBUTION OF RELATIVE WEIGHTS IN WHITE INDUCTEES

Percent Standard Weight	Age 17	18	19	20	21	22	23	24
59.6- 64.5			0.06					
64.6- 69.5						0.24		
69.6- 74.5	0.05	0.09					0.16	0.18
74.6- 79.5	0.21	0.25	0.51	0.77	1.70	0.48	0.48	0.73
79.6- 84.5	1.62	2.24	2.83	2.32	3.16	3.12	3.02	4.40
84.6- 89.5	6.96	6.70	7.27	7.73	7.52	9.35	8.41	7.34
89.6- 94.5	13.98	13.29	13.83	12.89	16.26	13.91	16.03	15.23
94.6- 99.5	21.01	19.78	17.11	17.65	18.69	16.79	18.25	14.86
99.6-104.5	20.44	18.95	17.62	20.36	17.96	17.03	18.25	17.06
104.6-109.5	15.21	15.79	15.82	14.05	15.05	12.47	11.43	14.50
109.6-114.5	8.92	9.52	10.29	11.21	7.04	10.07	7.94	8.62
114.6-119.5	4.46	5.85	4.57	5.03	4.13	7.43	4.92	6.24
119.6-124.5	3.03	3.28	3.60	3.35	1.94	4.08	3.33	4.22
124.6-129.5	1.57	1.46	1.99	1.55	1.70	2.40	2.54	2.57
129.6-134.5	1.06	1.02	1.93	0.77	1.70	0.72	2.06	1.47
134.6-139.5	0.42	0.72	0.84	0.77	1.70	0.24	0.79	0.92
139.6-144.5	0.37	0.39	0.58	0.52	0.73	0.72	1.11	0.73
144.6-149.5	0.25	0.25	0.64	0.26	0.48	0.24	0.32	
149.6-154.5	0.21	0.25	0.13	0.13		0.48	0.16	0.55
154.6-159.5	0.12	0.07	0.19	0.13		0.24	0.16	0.18
159.6-164.5	0.09	0.05	0.06	0.26	0.24		0.48	
164.6-169.5		0.05	0.13				0.16	
169.6-174.5	0.02			0.26				0.18
Number	4326	4327	1555	776	412	417	630	545
Mean	102.40	102.83	103.36	102.94	101.90	102.77	102.90	103.08
Standard Deviation	11.25	11.59	12.89	12.49	12.88	12.77	13.83	13.49

LINE OF BEST FIT FOR RELATIVE WEIGHT IN NEGROID MALE SEPARATEES

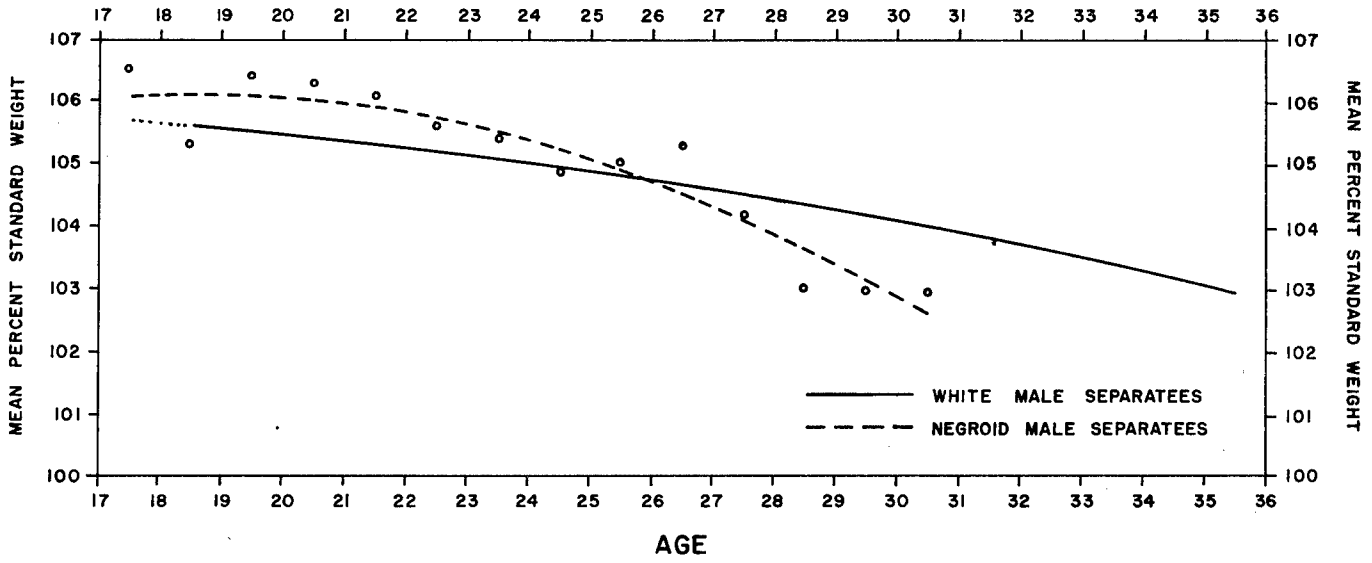


FIGURE 2

LINE OF BEST FIT FOR RELATIVE WEIGHT IN WHITE MALE INDUCTEES

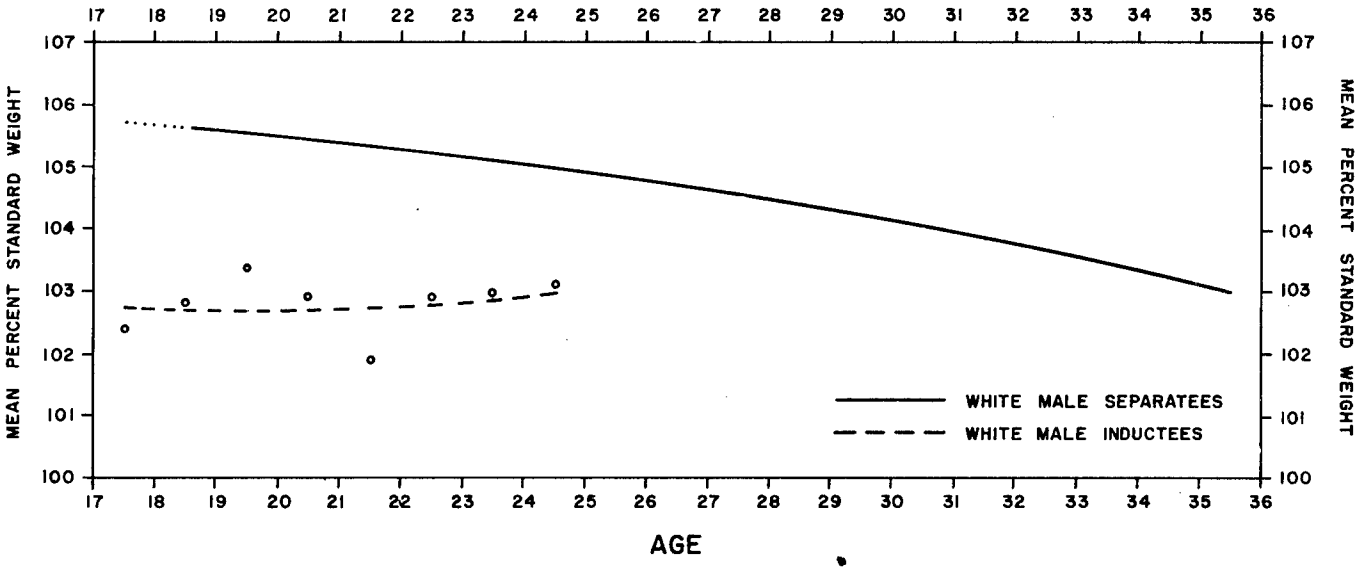


FIGURE 3

men without regard to age showed an even increment of weight. The average increase of weight for a one-inch increase in stature in the separatees was 3.8 pounds, and this increment, when used for adjustment in both directions from the modal stature group, agreed closely with the actual mean figures.

Another difference, previously noted, appears in Table VI. The medico-actuarial figures showed a greater increase in weight over the age-span compared, 19 through 35 years. For example, the 5' 8" column listed an increase of 13 pounds (142 to 155) while the Army data gave an increase of 11 pounds (151 to 162) for the same age-span. Thus, the difference at age 19 is 9 pounds, and the difference at age 35 is only 7 pounds. This partially explained the downward trend of the Army age-weighted line in Figure 1, but it is doubtful if it can entirely explain the slope of the plotted means. Furthermore, this purely mechanical and statistical explanation does not answer the question of why the Army data showed divergence with age from the medico-actuarial figures.

A new set of data for the compilation of height-weight standards has recently become available and has been compared with the White separatee series. These data were compiled on applicants for ordinary life insurance in 1940 by the Equitable Life Assurance Society of the United States, and the exact procedure used in ordering the data was supplied by the Society. A graphic representation of the average weights for selected heights was illustrated in the Journal of the American Medical Association,[4] and this presentation has been used here in Figure 4. The Army data means given in Table VI have been adjusted to correspond to the methods used by the Equitable Life Assurance Society actuaries.

The lines connecting adjusted average weights in Figure 4 present puzzling discrepancies between the series. It is obvious that the Army men of average stature or less are heavier than this 1940 civilian group, and the reverse is true of the soldiers who are taller than average. Furthermore, the incongruity in the tall-statured groups is accentuated with age to give a considerably different slope to the lines. There is no obvious reason for this difference, but the data clearly indicate that it exists. Is there some selective pressure in military life which inhibits the accumulation of body fat with age in tall men but not in short men?

It is further apparent that the large weight difference found between the Army series and the 1912 medico-actuarial table is not present when Army separatees and 1940 civilians are compared. The Army men probably would still be the heavier if the series were compared without reference to stature on an age-group basis, but the excess would be far less.

[4] JAMA 150:no. 2. page 39, Sept. 1952. Adv. Pfizer Spectrum.

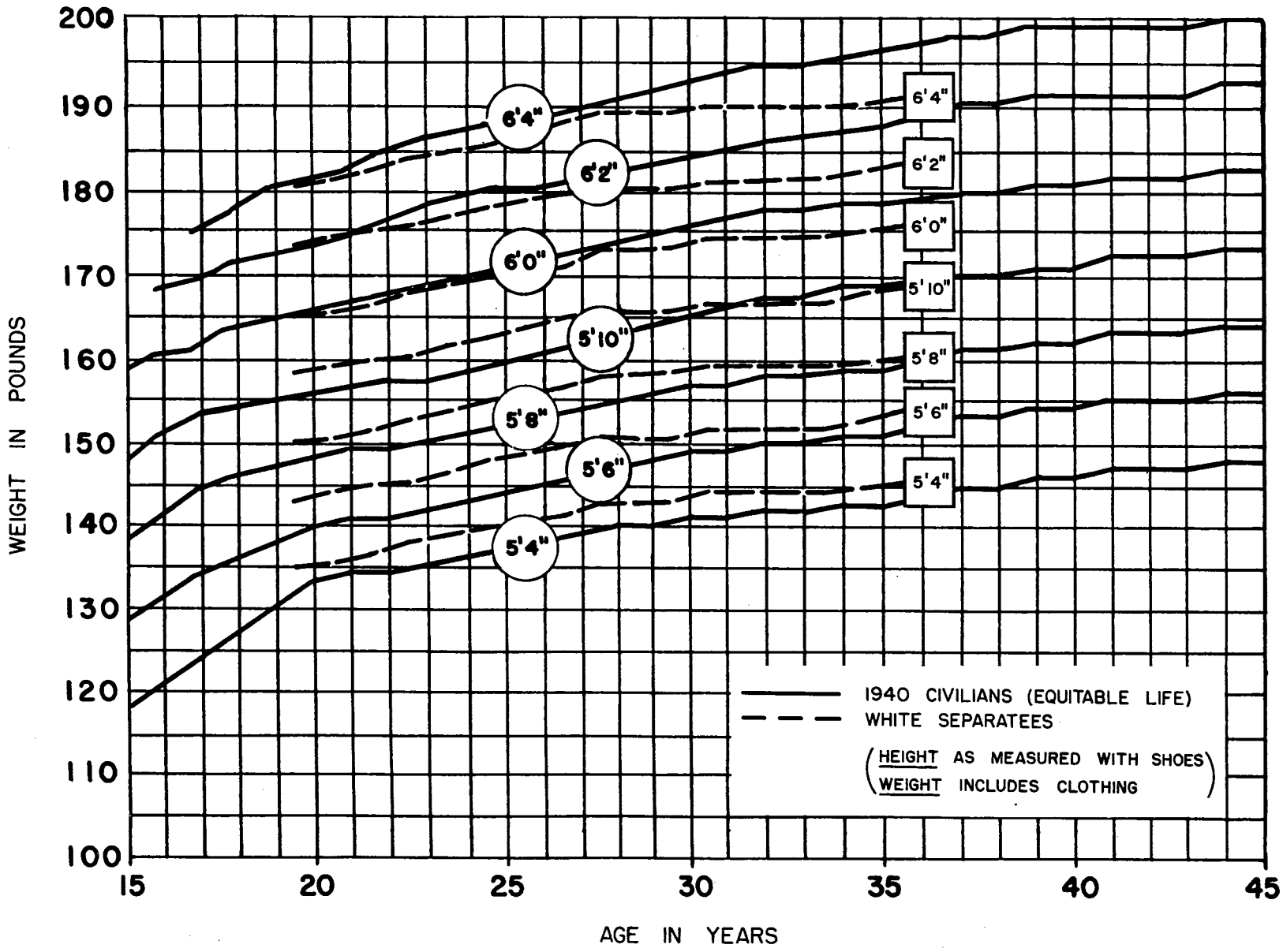
TABLE VI: COMPARISON OF GRADED AVERAGE WEIGHT FOR DIFFERENT STATURES AT VARIOUS AGES

AGE YEARS	5' 2"	5' 3"	5' 4"	5' 5"	5' 6"	5' 7"	5' 8"	5' 9"	5' 10"	5' 11"	6' 0"	6' 1"	6' 2"	6' 3"
19 [1]	*128*	*132*	*136*	*140*	*143*	*147*	*151*	*155*	*159*	*162*	*166*	*170*	*174*	*178*
19 [2]	120	123	126	130	134	138	142	146	150	155	160	165	170	175
20	*129*	*133*	*137*	*141*	*144*	*148*	*152*	*156*	*160*	*163*	*167*	*171*	*175*	*179*
	122	125	128	132	136	140	144	148	152	156	161	166	171	176
21	*130*	*134*	*138*	*142*	*145*	*149*	*153*	*157*	*161*	*164*	*168*	*172*	*176*	*180*
	123	126	130	134	138	141	145	149	153	157	162	167	172	177
22	*131*	*135*	*139*	*143*	*146*	*150*	*154*	*158*	*162*	*165*	*169*	*173*	*177*	*181*
	124	127	131	135	139	142	146	150	154	158	163	168	173	178
23	*132*	*136*	*140*	*144*	*147*	*151*	*155*	*159*	*163*	*166*	*170*	*174*	*178*	*182*
	125	128	132	136	140	143	147	151	155	159	164	169	175	180
24	*133*	*137*	*141*	*145*	*148*	*152*	*156*	*160*	*164*	*167*	*171*	*175*	*179*	*183*
	126	129	133	137	141	144	148	152	156	160	165	171	177	182
25	*134*	*138*	*142*	*146*	*149*	*153*	*157*	*161*	*165*	*168*	*172*	*176*	*180*	*184*
	126	129	133	137	141	145	149	153	157	162	167	173	179	184
26	*135*	*139*	*143*	*147*	*150*	*154*	*158*	*162*	*166*	*169*	*173*	*177*	*181*	*185*
	127	130	134	138	142	146	150	154	158	163	168	174	180	186
27	*136*	*140*	*144*	*148*	*151*	*155*	*159*	*163*	*167*	*170*	*174*	*178*	*182*	*186*
	128	131	134	138	142	146	150	154	158	163	169	175	181	187
28	*136*	*140*	*144*	*148*	*151*	*155*	*159*	*163*	*167*	*170*	*174*	*178*	*182*	*186*
	129	132	135	139	143	147	151	155	159	164	170	176	182	188
29	*136*	*140*	*144*	*148*	*151*	*155*	*159*	*163*	*167*	*170*	*174*	*178*	*182*	*186*
	130	133	136	140	144	148	152	156	160	165	171	177	183	189
30	*137*	*141*	*145*	*149*	*152*	*156*	*160*	*164*	*168*	*171*	*175*	*179*	*183*	*187*
	130	133	136	140	144	148	152	156	161	166	172	178	184	190
31	*137*	*141*	*145*	*149*	*152*	*156*	*160*	*164*	*168*	*171*	*175*	*179*	*183*	*187*
	131	134	137	141	145	149	153	157	162	167	173	179	185	191
32	*137*	*141*	*145*	*149*	*152*	*156*	*160*	*164*	*168*	*171*	*175*	*179*	*183*	*187*
	131	134	137	141	145	149	154	158	163	168	174	180	186	192
33	*137*	*141*	*145*	*149*	*152*	*156*	*160*	*164*	*168*	*171*	*175*	*179*	*183*	*187*
	131	134	137	141	145	149	154	159	164	169	175	181	187	193
34	*138*	*142*	*146*	*150*	*153*	*157*	*161*	*165*	*169*	*172*	*176*	*180*	*184*	*188*
	132	135	138	142	146	150	155	160	165	170	176	182	188	194
35	*139*	*143*	*147*	*151*	*154*	*158*	*162*	*166*	*170*	*173*	*175*	*181*	*185*	*189*
	132	135	138	142	146	150	155	160	165	170	176	182	189	195

[1] *ARMY SEPARATEES*

[2] MEDICO – ACTUARIAL

COMPARISON OF ADJUSTED AVERAGE WEIGHT BETWEEN WHITE SEPARATEES AND 1940 CIVILIANS



4. Discussion

a. Any discussion of the importance of the data presented here must be in terms of the uses to which the concept of relative or standard weight is put in practice. Three examples should illustrate the utility or lack of utility of the concept and present standards. These three uses are: (1) in nutritional assessment, (2) as a predictor of differential morbidity and mortality (i.e., insurance risk), and (3) as an exclusion factor for military service.

1) The concept of relative weight is sufficiently simple and the tabular presentation of standard height-weight tables is widespread enough to make nutritional assessment by this method available to non-professional as well as medical personnel. The basic assumption underlying the method is: the average is normal and deviations from the average become increasingly abnormal. If this assumption is accepted as true for the moment, then the average is "normal" regardless of what value the average takes. Admittedly, this becomes invalid in times of famine and privation. It thus follows logically that the standard should accurately reflect the population at all times, and standards must be revised if and when the average weight of the population (corrected for age and stature) changes. The newer data presented here, both on the Army series and the 1940 civilians, clearly indicate that weight changes have occurred since the collection of the 1912 medico-actuarial statistics. This cannot logically be interpreted to mean that American men are now generally overweight, because the former standard is now obsolete. It is a well-attested fact that the past generation or two has seen a slight but significant increase in average male stature in this country. Biologically, it is inconceivable that this stature increase could occur without a concomitant though small increase in body weight since the elongation of bone which constitutes the height increase must have physical weight. The most reasonable explanation of the increase in stature is the improvement of childhood nutrition in that period. This in turn should provide somewhat larger musculature and adipose tissue depots which together would be the major source of the weight increase which has been noted.

2) The use of relative weight in the estimate of insurance risk follows the same assumption as nutritional assessment, with emphasis on the pathology of deviations from the standard. It is based on the demonstrated association between high relative weight and certain circulatory dysfunctions. There are two unfortunate limitations to this association. One, since the increase in circulatory dysfunction is roughly proportional to the increase in relative weight, no single limit can be established between the normal and the pathological or between the good and the bad risk. Two, the correspondence between disease and relative weight is undoubtedly indirect. The association is with the accumulation of large amounts of body fat and weight simply reflects the presence of this fat in addition to all other bodily components. What is really required is an accurate assessment of body fat and the discontinuance

of relative weight as a criterion. Such a technique is now available[5] and new and proper standards could be devised. It must be stated, however, that neither the measurement of fat nor any other similar measure is likely to make possible a single limiting value which will differentiate between normal and abnormal. There must be an infinite series of deviations or gradations from the average in any measure which is distributed along a continium in the population.

3) The Army uses relative weight for induction standards with an emphasis which is the opposite of the area of life insurance interest. The military standards are designed to prevent or at least minimize the acceptance of underweight personnel and no rigid upper limit for weight standards is used. The pertinent regulation AR 40-115, Physical Standards and Physical Profiling, Section IV, states that men are acceptable "provided the overweight is not so excessive as to interfere with military training". On the other hand, minimum acceptable values for weight are given as well as standard values and these have been tabled below:

Height	Weight		Minimum Weight Expressed as a Percent of Standard Weight
	Standard	Minimum	
inches	pounds		percent
60	116	105	90.5
61	119	107	89.9
62	122	109	89.3
63	125	111	88.8
64	128	113	88.3
65	132	115	87.1
66	136	117	86.0
67	140	121	86.4
68	144	125	86.8
69	148	129	87.2
70	152	133	87.5
71	156	137	87.8
72	160	141	88.1
73	164	145	88.4
74	168	149	88.7
75	172	153	89.0
76	176	157	89.2
77	180	161	89.4
78	184	165	89.7

The far-right column which was calculated from the standard and minimum values shows a slightly larger allowable deviation in men of medium stature, the reason for which is not apparent. The standard and minimum weights do not take age into account but the standard values show a remarkable correspondence to the medico-actuarial averages for age 20 (see Table II).

[5]Newman, R.W. Measurement of Body Fat in Stress Situations. EPB Report No. 193. OQMG. Nov. 1952.

The minimum weight standards, with the exception of the 105-pound minimum weight, may be disregarded by the examining physician if he feels that it is temporary and correctable, but the soldier is given the lowest acceptable physical profile classification. It was evidently disregarded to some extent in the Army data presented here, since 9.87 percent of the men shown in Tables III, IV, and V fall into relative weight categories of 89.5 percent or less. It is difficult to see how any arbitrary values of minimum weight for a given height can successfully weed out unfit individuals, but a system which is based on the most recent data and takes age into account should be more accurate. What are really needed are minimum standards based on lean body weight (obtainable through assessment of body fat). The standards obviously should exclude men with insufficient musculature satisfactorily to perform military tasks and not penalize men whose musculature is adequate but who are low in weight because they are low in fat.

5. Summary and Conclusions

The essential elements of the data presented here for the first time have been graphically illustrated in Figure 5.

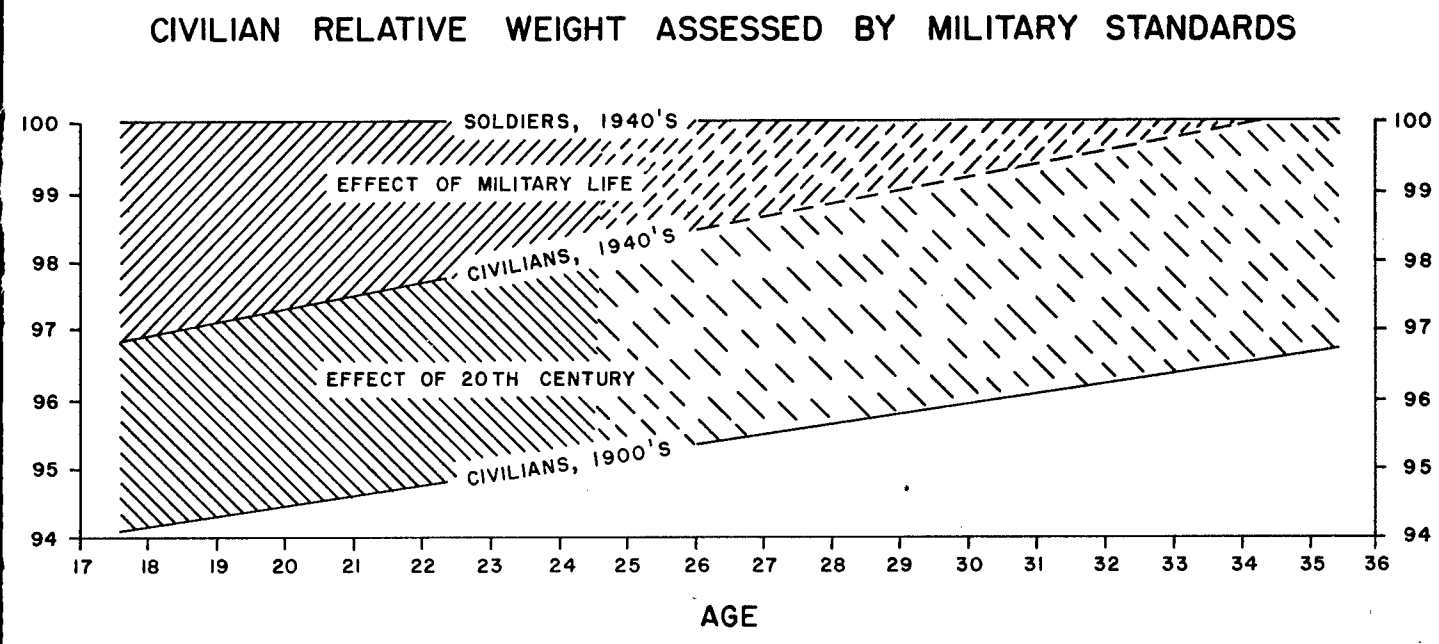


FIGURE 5

These are: (1) the 1912 medico-actuarial data appear obsolete when a modern military population is judged by these standards; (2) the civilian population of the 1940's, measured at the time of induction into the Army, appears to lie approximately midway between the military and 1912 series; and (3) some unidentified military factor caused a differential addition of weight with age. The method of presentation used in Figure 5 reverses the baselines employed in Figures 1, 2, and 3; in this case the Army

separatees form the 100 percent line and the inductees and 1912 civilians were plotted against the separatees. This change was made for two reasons: (1) because it is felt that the use of an obsolete series as the standard tends to perpetuate the status quo, and (2) that even though the Army separatees obviously constitute a specialized group, they also reflect in many ways a state of physical conditioning with adequate nutrition which best approaches our concept of an optimum physical state. Figure 5 has been deliberately simplified to emphasize the important points and leave a more vivid impression. It is not the intention of this report to suggest that the Army series presented here are the answer to a new evaluation of height-weight standards, but merely to illustrate the pressing need for such.

6. Recommendations

That new and better data be accumulated to replace the obsolete height-weight standards now in use. That the development of a physical standard criterion which avoids the limitations of relative weight be prosecuted and supported.

7. Acknowledgements

The author wishes to acknowledge the assistance of the members of the Anthropology Unit, especially Mr. Morris A. Cohen, who performed most of the necessary and tedious calculations in the accumulation of the Army data presented here.

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1 School of Aviation Medicine, Randolph AFB, Tex.

NAVY

1 BUREAU OF SUPPLIES & ACCOUNTS, Clothing Div., 4048 Arl Ann, Washington 25, D. C. (Attn: Lt. W. K. Woodard)

1 CO, NAVAL CLOTHING DEPOT, 29th St. & 3rd Ave., Brooklyn, N. Y.

OFFICE OF NAVAL RESEARCH, Washington 25, D. C.

1 Navy Res. Sec., Library of Congress (Attn: Mr. J. H. Heald)

MARINE CORPS

1 Supply Dept., Gen. Supply Sec., Room 4136, USMG Wg., Arl Ann, Washington 25, D. C. (Attn: Col. J. F. Stamm)
1 USMC Supply Depot, 1100 S. Broad St., Philadelphia, Pa. (Attn: Capt. Misura)

CIVILIAN

1 U. S. NATIONAL MUSEUM, Div. of Physical Anthropology, Washington 25, D. C. (Attn: Dr. T. Dale Stewart)

1 DEPT. OF COMMERCE, Civil Aeronautics Administration, Aviation Med. Service, Washington 25, D. C. (Attn: Dr. Barry G. King)

1 CENTRAL INTELLIGENCE AGENCY, Washington 25, D. C. (Attn: Dr. James M. Andrews)